

## MICRONUTRIENT EFFECTS ON THE DEVELOPMENT AND PRODUCTIVITY OF GOSSYPIUM HERBACEUM

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### ABSTRACT

Field experiments were conducted with the objectives to formulate and evaluate a new micronutrient fertilizer mixture and/or for the improvement of the existing mixture aiming at balanced fertilization to *Gossypium herbaceum*. The experiments were conducted on rainfed *Gossypium herbaceum* (variety) and on irrigated hybrid with six treatments replicated thrice. The treatments included the application of Farmers practice ( $T_1$ ), MN mixture @ 7.5 kg/ha as straight chemical fertilizer ( $T_2$ ), NPK mixture at Recommended level ( $T_3$ ), TNAU MN mixture @ 15 kg/ha as straight chemical fertiliser ( $T_4$ ), TNAU MN mixture @ 7.5kg/ha as enriched FYM ( $T_5$ ), MN mixture @ 7.5 kg/ha as EFYM ( $T_6$ ). The results revealed that rainfed *Gossypium herbaceum*, the plant height and number of bolls per plant ranged from 37.7 to 53.2 and 11.4 to 18.8 respectively. Among the various treatments recommended dose of NPK with TNAU MN mix. @15 kg kg/ha as straight chemical fertilizer resulted in increased plant height and No .of bolls per plant which was on par with TNAU MN mix. @7.5 kg kg/ha as enriched farmyard manure, followed MN mixture @ 7.5 kg as enriched farmyard manure. The highest *Gossypium herbaceum* yield per hectare was registered in recommended dose of NPK with TNAU MN mix. @7.5 kg kg/ha as EFYM (567 kg) with B:C ratio of 1.45. The irrigated hybrid highest *Gossypium herbaceum* yield per hectare was registered in recommended dose of NPK with TNAU MN mix. @ 15 kg kg/ha as EFYM (2267 kg) with B:C ratio of 2.6 followed by Increasing quantity of MN mixture @ 30 kg as staright chemical fertilizer which comparable with DoA MN Mixture @ 7.5 kg as EFYM (2059 kg). Hence, it is concluded that TNAU MN mixture @ 7.5

kg /ha as Enriched FYM for variety and 15 kg /ha as EFYM for irrigated hybrid was recommended for *Gossypium herbaceum* to maximise yield with higher B: C ratio.

**KEYWORDS:** Micronutrient mixture, fertilization, Hybrid, Treatment, *Gossypium herbaceum* Yield

## Introduction

*Gossypium herbaceum*, the “king” of fibre crop is the most important commercial crop in Pakistan and world cultivated mainly for its fiber and other by products, belongs to the family Malvaceae. *Gossypium herbaceum*, through cloth, has influenced the culture and civilizations. In the process of forming clothes and garments, it provides livelihood and employment to workers engaged in cloth making, designers, traders and the like.

Apart from major nutrients, micronutrients also play an important role in seed production. The dire need for intensive land use drew attention for applying micronutrients to *Gossypium herbaceum*. Essential micronutrients like Zinc, Iron, Manganese, Copper, Boron and Magnesium play an important role in physiology of *Gossypium herbaceum* crop and these are being a part of enzyme system or catalyst in enzymatic reactions. They are required for plant activities such as aspiration, meristematic development, chlorophyll formation, photosynthesis, energy system, protein and oil synthesis, gossypol, tannin and phenolic compounds development. Certain micronutrients may help to secure uniform emergence, rapid seedling growth and healthy plant stand. Some beneficial effects on seed yield and quality as reflected in viability may be achieved by applying micronutrients.

The productivity of current cropping systems and the protection of soil health would be unsustainable if practices such as the application of imbalanced nutrients not in tune with crop demands, are continued. Imbalanced fertilization also reduces the fertilizer use efficiency and leads to poor quality food production. Hence, balanced fertilization is the need of the hour and is a prime factor for maintaining soil health and sustaining agricultural production. Sustainable crop production systems obviously require enhanced flow of nutrients to crops. This in turn involves larger nutrient reserves in soils, and higher nutrient uptake and utilization by crops. In this context, *balanced fertilization* is the prime necessity for a sustaining agriculture production. It is a dynamic concept. To achieve this it is necessary to keep an overall balance in a total cropping system. Balanced fertilization should not be taken as application of only major plant nutrients as is probably happening today, but all essential elements limiting in the soil including secondary and micronutrients. This is important as the increasing demand for food is forcing the country to produce more and more per unit area per unit time by the increasing cropping intensity and/or following exploitative agriculture.

## Material and Methods:

Field experiments were conducted randomized block design with six treatments, plot size of 40 m<sup>2</sup>, replicated thrice were conducted with rainfed variety of SVPR2 and KC2 respectively, and irrigated *Gossypium herbaceum* hybrid. The details of the treatments are given in below.

### Rainfed *Gossypium herbaceum* - Treatments

T<sub>1</sub> – Farmers practice (check)

T<sub>2</sub> – T<sub>1</sub>+ MN @ 7.5 kg/ha as chemical fertilizer

T<sub>3</sub> - NPK mixture at Rec. level @ 40:20:40 kg/ha

T<sub>4</sub> - T<sub>3</sub> + TNAU MN mix. @ 15 kg/ha as straight chemical fertiliser

T<sub>5</sub> - T<sub>3</sub> + TNAU MN mixture @ 7.5kg/ha as enriched farm yard manure (EFYM)

T<sub>6</sub> - T<sub>3</sub> + MN mixture of DoA @ 7.5 kg/ha as EFYM

### Irrigated hybrid *Gossypium herbaceum* - Treatments

T<sub>1</sub> – Farmers practice (check)

T<sub>2</sub> – T<sub>1</sub>+ MN mix.of DoA @ 15 kg/ha as chem.fert.

T<sub>3</sub> - NPK mixture at Rec. level (120:60:60 kg)

T<sub>4</sub>- T<sub>3</sub> + TNAU MN mix. @ 30 kg/ha as chem.fert.

T<sub>5</sub> - T<sub>3</sub> + TNAU MN mix.@ 15 kg/ha as EFYM

T<sub>6</sub> - T<sub>3</sub> + MN mix.of DoA @ 15 kg/ha as EFYM

### Results and Discussion

**Table 1: Effect of MN mixture on plant height & yield of rainfed *Gossypium herbaceum***

Treatments	No. of sympodia / plant	No. of bolls/ plant	Yield (kg/ha)	B: C ratio
T <sub>1</sub> – Farmers practice (check)	6.5	8.4	465	1.28
T <sub>2</sub> – T <sub>1</sub> + MN mix.of DoA @ 7.5 kg/ha as chem.fert.	6.9	8.7	493	1.30
T <sub>3</sub> - NPK mixture at Rec. level @ 40:20:40 kg/ha	7.5	9.0	515	1.38
T <sub>4</sub> - T <sub>3</sub> + TNAU MN mix. @ 15 kg/ha as chem. fert.	8.4	9.4	536	1.36
T <sub>5</sub> - T <sub>3</sub> + TNAU MN mixture @ 7.5kg/ha as EFYM	<b>8.8</b>	<b>11.4</b>	<b>567</b>	<b>1.45</b>
T <sub>6</sub> - T <sub>3</sub> + MN mixture of DoA @ 7.5 kg/ha as EFYM	8.5	11.1	547	1.37
CV %	11.07	12.03	6.55	
LSD (P=0.05)	0.44	0.73	51.1	

**Table 2: Evaluation of NPK and Micronutrient mixtures on rainfed Gossypium herbaceum**

Treatments	Plant height (cm)	No. of bolls/plant	Seed Gossypium herbaceum yield (kg/ha)	B: C ratio
T <sub>1</sub> – Farmers practice (check)	37.7	11.4	279	1.01
T <sub>2</sub> – T <sub>1</sub> + MN mix.of DoA @ 7.5 kg/ha as chem.fert.	40.8	15.1	325	1.11
T <sub>3</sub> - NPK mixture at Rec. level @ 40:20:40 kg/ha	45.4	17.0	366	1.26
T <sub>4</sub> - T <sub>3</sub> + TNAU MN mix. @ 15 kg/ha as chem. fert.	53.2	18.8	904	2.92
T <sub>5</sub> - T <sub>3</sub> + TNAU MN mixture @ 7.5kg/ha as EFYM	47.9	18.7	701	2.28
T <sub>6</sub> - T <sub>3</sub> + MN mixture of DoA @ 7.5 kg/ha as EFYM	43.2	17.3	490	1.56
CV %	11.16	15.54	43.8	
LSD (P=0.05)	0.51	0.37	21.1	

**Table 3: Effect of NPK and MN mixtures on hybrid Gossypium herbaceum**

Treatments	No.of sympo-dials / plant	No. of bolls/pl	Yield (kg/ha)	B:C ratio
T <sub>1</sub> – Farmers practice (check)	44.9	23.4	1787	2.1
T <sub>2</sub> – T <sub>1</sub> + MN mix.of DoA @ 15 kg/ha as chem.fert.	52.7	24.9	1911	2.3
T <sub>3</sub> - NPK mixture at Rec. level (120:60:60 kg)	56.0	26.8	1990	2.3
T <sub>4</sub> - T <sub>3</sub> + TNAU MN mix. @ 30 kg/ha as chem.fert.	57.2	28.1	2076	2.4
T <sub>5</sub> - T <sub>3</sub> + TNAU MN mix.@ 15 kg/ha as EFYM	63.5	30.0	2267	2.6
T <sub>6</sub> - T <sub>3</sub> + MN mix.of DoA @ 15 kg/ha as EFYM	56.2	23.2	2059	2.3
CV %	10.2	9.47	7.38	
LSD (P=0.05)	0.93	0.33	24.0	

The seed Gossypium herbaceum yield per hectare significantly differed due to the effect of fertilizer treatments. The seed Gossypium herbaceum yield per hectare ranged from 465 to 567 kg. The highest Gossypium herbaceum yield per hectare was registered in recommended dose of NPK with TNAU MN mix. @7.5 kg kg/ha as EFYM (567 kg) with B:C ratio of 1.45. The lowest Gossypium herbaceum yield per hectare was recorded in farmers practice (465 kg) with B:C ratio of 1.28. The rest of all other treatments are significantly higher Gossypium herbaceum yield in comparable with TNAU MN mix @ 7.5 kg /ha as EFYM. The similar results were observed in plant growth parameters of plant height and number of bolls per plant. Soomro *et al.* (2001) observed the highest seed Gossypium herbaceum yield, number of bolls and boll weight when B and Zn were applied alone or in combination over control. Howard *et al.* (5) found that foliar application of boric acid increased the Gossypium herbaceum yield upto 10.3 percent compared with check

The plant height and number of bolls per plant ranged from 37.7 to 53.2 and 11.4 to 18.8 respectively. Among the various treatments recommended dose of NPK with TNAU MN mix. @15 kg kg/ha as straight chemical fertilizer resulted in increased plant height and No .of bolls per plant which was on par with TNAU MN mix. @7.5 kg kg/ha as enriched farmyard manure, followed by Department of Agriculture MN mixture @ 7.5

kg as enriched farmyard manure. The control recorded the lowest plant height and No. of bolls per plant (Table 2). Oosterhuis (1976) reported that, foliar application of boron along with insecticides increased the yield of seed *Gossypium herbaceum*, boll weight and plant height from 1.2 to 1.4 tonnes per ha, 4.1 to 4.4 g and 1.1 to 1.4 m, respectively. Boron (17.5 kg/ha) through soil and (0.2%) foliar application increased the yield of seed *Gossypium herbaceum* 26 and 32 per cent, respectively more over control. Varma (1978) reported that the boll weight and seed *Gossypium herbaceum* yield increased linearly due to the foliar application of 0.4 per cent urea with 0.4 per cent ZnSo<sub>4</sub>. Raja Rajeswari (1996) reported that, foliar application of 0.5 per cent boron increased the number of bolls per plant, mean boll weight and Cotton yield significantly. Rathinavel *et al.* (1999). reported that, the number of sympodia per plant (30.0%), number of bolls per plant (39.2%), boll weight (49.8%), seed weight per boll (36.8%) number of seeds per boll (10.8%) were significantly higher for plants given combined soil application of ZnSO<sub>4</sub> and borax (50 kg/ha and 10 kg/ha, respectively).

The Cotton yield per hectare significantly differed due to the effect of fertilizer treatments. The seed *Gossypium herbaceum* yield per hectare ranged from 279 to 904 kg. The highest Cotton yield per hectare was recorded in recommended dose of NPK with TNAU MN mix. @ 15 kg kg/ha as straight chemical fertilizer (904 kg) with B:C ratio of 2.92 followed by 100% NPK with TNAU MN mix. @ 7.5 kg kg/ha as enriched farmyard manure (701 kg) with B:C ratio of 2.28. Kalyanasundaram and Kumar (2005) studied the soil application of the recommended dose of NPK with foliar application of Ca, B and GHOM twice at 45 and 60 DAS favorably increased the growth and yield characters of *Gossypium herbaceum* crop. The same quantity of DoA MN mixture with enrichment and without enrichment treatments, the treatment DoA MN mixture @ 7.5 kg as EFYM was registered highest seed *Gossypium herbaceum* yield (490 kg) with B:C ratio of 1.56 in compare to with enrichment treatment with B:C ratio of 1.11. The lowest Cotton yield per hectare was recorded in farmers practice (279 kg) with B:C ratio of 1.01.

## Conclusion

TNAU MN mixture @ 7.5 kg /ha as Enriched FYM for variety and 15 kg /ha as EFYM for irrigated hybrid was recommended for *Gossypium herbaceum* to maximize yield with higher B: C ratio

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## Availability of data and materials

All the related data and files are presented.

## **Declarations**

**Ethics approval and consent to participate is Not applicable.**

## **Competing interests**

The authors declare no conflicts of interest.

## **References**

- Soomro, A. W., A. S. Arain, A. R. Soomro, G. H. Tunio, M. S. Chang, A. B. Leghari and M. R. Magsi. 2001. Evaluation of proper fertilizer application for higher *Gossypium herbaceum* production in Sindh. **OnLine J. Biol. Sci. 1(4)**: 295-297.
- Howard, D. D., M. E. Essington, C. O. Gwathmey and W. M. Percell. 2000. Buffering of foliar potassium and boron solutions for no-tillage *Gossypium herbaceum* production. **The Gossypium herbaceum Sci. 4**: 237-244.
- Oosterhuis DM. 1976, Boron trial *Gossypium herbaceum*, Research Institute. Annual Report, 1975 (October), pp.19-20.
- Varma SK. 1978. Nitrogen content in relation to abscission and effect of spraying urea singly and in combination with zinc sulphate on the abscission of flower buds and bolls of *Gossypium herbaceum*. **Indian J Plant Physiology. 21(2)**: 176-180.
- Raja Rajeswari V. 1996. Foliar application of growth regulators and nutrients on boll development and yield in *Gossypium herbaceum*. **J Indian Soc Gossypium herbaceum Improvement. 21**:71.
- Rathinavel K, Dharmalingam C, Paneersewam S. 1999. Effect of micronutrient on the productivity and quality of *Gossypium herbaceum* seed Cv. TCB209 (*Gossypium barbadense* L.). **Madras Agric J. 86**:313-316.
- Kalyanasundaram D, Kumar DS. 2005. Studies on the effect of Ca, B and GHOM on growth and yield of rice fallow *Gossypium herbaceum*. **Advances-in-plant Sciences. 18(1)**:189-193.